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Population-attributable burden of modifiable risk factors for depression and anxiety among reproductive-age women in Nepal

Santosh Giri^{1,†}, Nancy Ross², Rachel Kornhaber³, Allen G. Ross¹, Kedir Y Ahmed¹, Pushpanjali Adhikari⁴, M. Mamun Huda¹, Anayochukwu E. Anyasodor¹, Feleke H. Astaweseegn¹, Shakeel Mahmood¹, Subash Thapa¹

Institutional addresses:

¹Rural Health Research Institute (RHRI), Charles Sturt University, Orange, NSW, Australia

²School of Social Work, Dalhousie University, K'jipuktuk Halifax, Nova Scotia, Canada

³School of Nursing, Paramedicine and and Healthcare Sciences, Charles Sturt University, Bathurst, NSW, Australia

⁴Department of Community Programs, Dhulikhel Hospital, Dhulikhel, Kavrepalanchowk, Nepal

†Corresponding author:

Santosh Giri, MPH; E-mail: sgiri@csu.edu.au

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Abstract

Identifying the critical modifiable risk factors for anxiety and depression is crucial for reducing the increasing burden of mental illness among reproductive-aged women 15-49 years in Nepal. We investigated Population Attributable Fractions (PAFs) of generalized anxiety disorder and major depressive disorder attributable to potentially modifiable risk factors among reproductive-age women. This cross-sectional study analysed the data from the Nepal Demographic Health Survey in 2022. Multilevel logistic regression analyses determined odds ratio (ORs) for risk factors associated with depression and anxiety. PAFs adjusted for communality were calculated using adjusted ORs and prevalence estimates for each risk factor. This study included a weighted sample of 7,410 women, with a mean age of 30 (± 10) years. Highest PAFs of depression were associated with women who experienced emotional abuse (PAF: 18.2%; 95%CI: 15.4-20.2), physical violence (PAF: 12.1%; 95%CI: 5.1-16.7), and sexual abuse (PAF: 9.0%; 95%CI: 5.9-11.5), functional difficulty (PAF: 6.9%; 95%CI: 2.8-10.1) and food insecurity (PAF: 6.6%; 95%CI: 4.4-8.4). These five potentially modifiable risk factors accounted for 52.8% (95%CI: 33.7-67.0) of depression cases. Highest PAFs for anxiety were associated with women who experienced emotional abuse (PAF: 10.8%; 95%CI: 8.7-12.7), functional impairment (PAF: 7.8%; 95%CI: 5.7-9.6), physical violence (PAF: 7.8%; 95%CI: 4.4-10.6), sexual abuse (PAF: 5.6%; 95%CI: 3.9-7.3), and food insecurity (PAF: 3.7%; 95%CI: 2.4-4.9). These five potentially modifiable risk factors accounted for 35.7% (95%CI: 25.2-45.1) of anxiety cases. The results of this study

highlight the necessity of targeted strategies at the community and household levels to address violence against women. Couple-based approaches involving men are particularly relevant to break the cycle of intergenerational violence and fostering environments conducive for better mental health.

Keywords: Generalized anxiety disorder; major depressive disorder; emotional abuse; sexual abuse; population attributable fraction; violence against women

Introduction

Mental disorders represent a major and growing public health challenge worldwide and are among the leading contributors to disability, functional impairments, and premature mortality across the life course¹. Globally, an estimated 970 million people worldwide were living with mental disorders in 2019, with depressive and anxiety disorders accounting for the largest share of years lived with disability (YLDs) among all non-fatal health conditions². Beyond their contribution to disability, common mental disorders are associated with increased all-cause mortality, elevated risk of suicide, reduced labour force participation, lost productivity, and substantial health system and societal costs³⁻⁵. These impacts are particularly pronounced in low- and middle-income countries (LMICs) where 80% of people with mental disorders reside and where health systems often lack the capacity to provide comprehensive mental health care².

South Asia has experienced a marked increase in the burden of common mental disorders over the recent decades. Between 1990 and 2019, the incidence of depression increased from 2.8 million to 5.2 million (increased by 85%), and anxiety disorders increased from 24.1 million to 42.6 million (increased by 77%)⁶,

driven by population growth, social change, and persistent structural inequities⁷. Among South Asian countries, Nepal is facing an increasing burden of mental disorders among various age groups, including reproductive age women⁸. The National Mental Health Survey (2019–2020) found a higher prevalence of mental disorders among women (5.1%) compared to men (3.4%), with depressive and anxiety disorders being the most common conditions⁹. Reproductive-age women are a particularly vulnerable group, given their disproportionate exposure to gender-based violence, economic insecurity, restricted educational and employment opportunities, and caregiving burdens within the patriarchal social structures^{10,11}. These social and contextual disadvantages intersect with biological and psychosocial stressors during the reproductive years, increasing vulnerability to depression and anxiety and contributing to adverse consequences for women, children, and families⁷. Underlying social-contextual disadvantages and living with mental disorders are further associated with poor lifestyles, increased rates of chronic health conditions, suicidal tendencies, and premature deaths among reproductive age women¹².

Despite growing burden of mental disorders, access to mental health care in Nepal remains limited, particularly for women, rural populations and individuals with low socio-economic status⁹. Barriers operate at multiple levels, including limited mental health literacy, financial constraints, stigma, and weak institutional capacity within the health system^{9,13,14}. However, in settings where treatment coverage is constrained, focusing solely on expanding clinical services is unlikely to substantially reduce the population burden of common mental disorders. Increasing attention has therefore been directed toward prevention strategies that address upstream, modifiable social determinants of mental health such as violence against women, food insecurity, functional limitations, and gender

inequities that shape both mental health risk and access to care¹⁵. As suggested by the Lancet Commission on global mental health and sustainable development, LMICs including Nepal should make a shift from its focus on the ‘treatment gap’ to mental health as a ‘public good’¹⁶.

Progress in promoting mental health, and preventing mental disorders is unlikely to occur if efforts are not concentrated on addressing the social determinants of mental health¹⁷. Population Attributable Fractions (PAFs) estimates for depression and anxiety offer crucial insights for prioritizing interventions, allocating resources effectively, and designing tailored prevention strategies. While prior studies in Nepal and similar LMIC settings have largely focused on identifying correlates of depression and anxiety^{11,14,18-20}, few have quantified the potential population-level mental health gains associated with addressing modifiable social and gender-related risk factors, particularly among reproductive-age women. Addressing this gap is critical for informing prevention-oriented, policy-relevant mental health strategies in resource-constrained settings. Therefore, this study aimed to estimate the population attributable fractions of major depressive disorder and generalized anxiety disorder associated with key modifiable risk factors among reproductive-age women in Nepal, using nationally representative survey data.

Methods

Study design and data sources

This cross-sectional study analysed data from Nepal Demographic Health Survey (NDHS) conducted in 2022²¹. The survey of 2022 was the eighth demographic health survey conducted between January 5 and June 22, 2022. The NDHS gathers data on the demographics and health of individuals, encompassing topics such as maternal and child health, mortality, nutrition, and the social determinants of

health. A standardized Mental Health Module (MHM) was added to the survey questionnaire, for the first time, providing the opportunity to conduct this study.

Sampling procedures and sample size

NDHS uses a two-stage cluster sampling technique to select the study participants. In the first stage, seven provinces were stratified into 15 sampling strata, with 476 primary sample units chosen. A total of 14,280 households were interviewed, with 14,845 women and 4,913 men. The mental health module was completed by 12,323 individuals out of which 7,410 were women of reproductive age²¹, as presented in Figure 1.



Figure 1. Data flow for the analytic sample of reproductive-age women included in multilevel models and population attributable fraction (PAF) analyses, NDHS 2022

Outcome variables

The outcome variables were major depressive disorder and generalized anxiety disorder. Major depressive disorder was measured using Patient Health Questionnaire 9 (PHQ-9) (sensitivity=88%, specificity=88%) and generalized anxiety disorder was measured using Generalized Anxiety Disorder 7 (GAD-7) (sensitivity=92%, specificity=76%)²¹. Based on the cutoff measure used by NDHS 2022, PHQ-9 scores of 10 or more was defined as having depression and GAD-7 scores of 6 or more was defined as having anxiety symptoms²¹.

Modifiable risk factors

Modifiable risk factors were defined as exposures that are potentially actionable through policy, programmatic, or health-system interventions, even if not fully reversible at individual-level. These included: socio-economic factors, health risk behaviours, and gender-related factors. Socio-economic factors comprised household wealth index ('poorest', 'poorer', 'middle', 'richer', 'richest'), highest education attainment ('never attended school or primary education', 'secondary or higher'), employment ('not employed', 'employed'), functional difficulty ('no', 'yes'), and food insecurity ('no', 'yes'). Health risk behaviours included current smoking status ('no', 'yes') and alcohol consumption in the last month ('no', 'yes'). Gender-related factors included traditional separation practices during menstrual period ('no', 'yes'), justification of wife beating ('no', 'yes'), sexual negotiation ('no', 'yes'), involvement in decision-making ('no', 'yes'), experience of physical violence since the age of 15 ('no', 'yes'), ever experienced sexual abuse ('no', 'yes') and emotional abuse by the partner ('no', 'yes'). Potential covariates included age, marital status (grouped as married or unmarried) and province.

The household wealth index is a composite measure of relative economic status derived using principal component analysis (PCA) based on household asset ownership and access to services, including housing characteristics, water source, sanitation facilities, and ownership of consumer goods. Food insecurity was assessed using the Food Insecurity Experience Scale (FIES) in the NDHS, which captures food-related hardship over the previous 12 months²¹. Moderate insecurity reflects reduced food quality or quantity and uncertainty about obtaining food due to limited resources, while severe insecurity involves running out of food or going a day or more without eating. For analysis, food insecurity was

dichotomised into moderate/severe food insecurity (yes) versus food secure or mildly insecure (no).

Functional difficulty was defined based on self-reported limitations in performing basic activities of daily living due to physical, mental, cognitive, or sensory impairment. While such difficulties may not be fully reversible, they are considered modifiable in a public health context through access to healthcare, rehabilitation, social protection and disability-inclusive policies²². Experiences of physical, sexual, and emotional violence represent historical exposures that cannot be undone at the individual level. However, these factors were included as modifiable in terms of preventing future violence and mitigating their mental health consequences through legal protections, social support, trauma-informed care, and community-based interventions²³. Sexual negotiation reflects women's ability to refuse sex and negotiate safer sexual practices, while justification of wife beating was derived from women's acceptance of spousal violence under specific circumstances. Menstrual separation practices were measured based on reported social exclusion during menstruation.

Statistical analysis

We used weighted analysis accounting for the complex survey design using the 'survey' package²⁴ and presented the categorical variables as frequency and percentage (%) with 95% confidence interval (CI) while numerical variables as mean with 95% CI. Multilevel logistic regression models were fitted using generalized linear mixed models with a logit link, specifying random intercepts at cluster level to account for within-cluster correlation. NDHS individual-level sampling weights were incorporated directly into the models using the weights argument in 'glmmTMB' to adjust for unequal probabilities of selection²⁵. Adjusted

odds ratios (ORs) and 95% CIs were obtained by exponentiating model coefficients and their confidence limits. The reference group was those individuals who had GAD-7 scores less than 6 for anxiety and PHQ-9 scores less than 10 for depression.

For the individual risk factors significant in the multilevel regression model of potentially modifiable risk factors for anxiety and depression outcomes, we calculated the unadjusted PAF using Miettinen's formula²⁶: $PAF_e = P_e(OR_e - 1)/OR_e$, where P_e is the prevalence of the risk factor e and OR_e is the adjusted odds ratio of the anxiety or depression associated with the risk factor e .

The prevalence of specific risk factors was calculated using the weighted survey analysis for the reduced sample size in this study. Communality weights were computed to account for the overlap of risk factors across individuals, as adding up the PAFs for each risk factor would lead to an overestimation of their collective impact on anxiety or depression²⁷. Using the method outlined by Lee et al., the communality calculation involved performing a pairwise tetrachoric correlation analysis on the risk factors. This was followed by a PCA of the tetrachoric correlation matrix. For each risk factor, we calculated the sum of the squares of the loadings in all principal components with an eigenvector greater than 1. The weighting of each risk factor was determined using the formula²⁷: $W_e = 1 - communality_e$. The combined PAF was then calculated using^{26,27}: $PAF = 1 - [(1 - W_1*PAF_1) * (1 - W_2*PAF_2) * (1 - W_3*PAF_3)...]$.

Finally, the adjusted PAF for each risk factors were calculated using the formula^{26,27}: $PAF_e = ([PAF_e/\sum PAF_e] * \text{combined PAF})$. Statistical significance for regression analyses was assessed using a two-sided α level of 0.05, and population attributable fractions were reported with 95% confidence intervals to reflect

estimation uncertainty. Adjusted odds ratios used for PAF estimation were derived from multivariable regression models fitted to the analytic sample with complete data ($n = 4,202$), while exposure prevalence inputs were estimated from the full weighted NDHS sample of women of reproductive age ($N = 7,410$) to preserve population representativeness. All analyses were performed in R version 4.3.2²⁸. All methods were performed in accordance with relevant guidelines and regulations, including the principles outlined in the Declaration of Helsinki. Prior to each interview, informed consent was obtained from all participants. The present study used publicly available de-identified secondary data from the NDHS.

Results

Study participants

The study sample comprised of a weighted sample of 7,410 women (Table 1) with an average age of 30 (± 10) years. A total of 68.3% (5,064) of women resided in urban areas, and 26.2% (1,944) had no education. Only 4.3% (319) of women smoked and 23.5% (1,739) consumed alcohol in the last month. A total of 21.3% (1,581) had some form of functional difficulty and 7.8% (573) had moderate-to-severe food insecurity in their households.

Table 1. Characteristics of the study participants.

	Total population ^a (N=7,410)	Major Depressive Disorder ^b		Generalized Anxiety Disorder ^b	
		No (N=7,008)	Yes (N=403)	No (N=5,785)	Yes (N=1,626)
	n (%)	n (%)	n (%)	n (%)	n (%)
Province					
Bagmati	1,493 (20.2)	1,428 (95.6)	65 (4.4)	1,209 (81.0)	284 (19.0)
Koshi	1,241 (16.7)	1,161 (93.5)	80 (6.5)	939 (75.6)	302 (24.4)
Madhesh	1,512 (20.4)	1,436 (95.0)	76 (5.0)	1,179 (77.9)	333 (22.1)
Gandaki	704 (9.5)	676 (96.0)	28 (4.0)	579 (82.2)	125 (17.8)
Lumbini	1,360 (18.4)	1,293 (95.1)	67 (4.9)	1,062 (78.1)	298 (21.9)
Karnali	458 (6.2)	415 (90.7)	43 (9.3)	331 (72.2)	127 (27.8)
Sudurpaschim	641 (8.6)	598 (93.2)	43 (6.8)	486 (75.8)	155 (24.2)

Place of residence					
Urban	5,064 (68.3)	4,812 (95.0)	252 (5.0)	3,965 (78.3)	1,099 (21.7)
Rural	2,347 (31.7)	2,196 (93.6)	151 (6.4)	1,820 (77.5)	527 (22.5)
Household wealth index					
Poorest	1,344 (18.1)	1,257 (93.6)	86 (6.4)	1,051 (78.2)	293 (21.8)
Poorer	1,372 (18.5)	1,285 (93.7)	87 (6.3)	1,021 (74.5)	350 (25.5)
Middle	1,512 (20.4)	1,415 (93.6)	96 (6.4)	1,139 (75.4)	373 (24.6)
Richer	1,704 (23.0)	1,621 (95.1)	83 (4.9)	1,341 (78.7)	363 (21.3)
Richest	1,479 (20.0)	1,429 (96.6)	50 (3.4)	1,233 (83.3)	247 (16.7)
Education level					
No education	1,944 (26.2)	1,821 (93.7)	122 (6.3)	1,454 (74.8)	489 (25.2)
Basic	2,256 (30.4)	2,109 (93.5)	147 (6.5)	1,719 (76.2)	537 (23.8)
Secondary	2,931 (39.6)	2,802 (95.6)	129 (4.4)	2,369 (80.8)	562 (19.2)
Higher	280 (3.8)	275 (98.4)	5 (1.6)	243 (86.7)	37 (13.3)
Currently married					
No	1,893 (25.5)	1,796 (94.9)	97 (5.1)	1,514 (80.0)	380 (20.0)
Yes	5,517 (74.5)	5,211 (94.5)	306 (5.5)	4,271 (77.4)	1,246 (22.6)
Employment status					
Not employed	2,033 (27.4)	1,945 (95.7)	88 (4.3)	1,629 (80.1)	405 (19.9)
Employed	5,377 (72.6)	5,063 (94.2)	315 (5.8)	4,156 (77.3)	1,221 (22.7)
Functional difficulty					
No	5,830 (78.7)	5,563 (95.4)	266 (4.6)	4,711 (80.8)	1,119 (19.2)
Yes	1,581 (21.3)	1,444 (91.4)	137 (8.6)	1,074 (68.0)	507 (32.0)
Food insecurity					
No	6,821 (92.2)	6,500 (95.3)	321 (4.7)	5,408 (79.3)	1,413 (20.7)
Yes	573 (7.8)	493 (86.0)	80 (14.0)	364 (63.5)	209 (36.5)
Current smoking status					
No	7,091 (95.7)	6,715 (94.7)	376 (5.3)	5,559 (78.4)	1,532 (21.6)
Yes	319 (4.3)	292 (91.6)	27 (8.4)	226 (70.8)	93 (29.2)
Alcohol consumption in the last month					
No	5,672 (76.5)	5,378 (94.8)	293 (5.2)	4,473 (78.9)	1,198 (21.1)
Yes	1,739 (23.5)	1,629 (93.7)	110 (6.3)	1,312 (75.4)	427 (24.6)
Traditional separation practices during menstrual period					
No	903 (12.2)	855 (94.7)	48 (5.3)	690 (76.4)	213 (23.6)
Yes	6,507 (87.8)	6,152 (94.5)	355 (5.5)	5,095 (78.3)	1,412 (21.7)
Wife beating justified					
No	6,040 (81.5)	5,720 (94.7)	320 (5.3)	4,719 (78.1)	1,321 (21.9)
Yes	1,371 (18.5)	1,287 (93.9)	83 (6.1)	1,066 (77.8)	304 (22.2)

Sexual negotiation					
No	2,279 (30.8)	2,145 (94.1)	134 (5.9)	1,778 (78.0)	501 (22.0)
Yes	5,131 (69.2)	4,862 (94.8)	269 (5.2)	4,007 (78.1)	1,124 (21.9)
Household decision-making					
No	2,909 (52.6)	2,732 (93.9)	176 (6.1)	2,230 (76.6)	679 (23.4)
Yes	2,624 (47.4)	2,494 (95.1)	129 (4.9)	2,055 (78.3)	569 (21.7)
Experienced physical violence since age 15					
No	3,920 (76.2)	3,792 (96.7)	128 (3.3)	3,237 (82.6)	683 (17.4)
Yes	1,227 (23.8)	1,074 (87.5)	153 (12.5)	778 (63.5)	448 (36.5)
Ever experienced sexual abuse					
No	4,741 (92.1)	4,540 (95.8)	200 (4.2)	3,815 (80.5)	925 (19.5)
Yes	406 (7.9)	326 (80.2)	81 (19.8)	200 (49.3)	206 (50.7)
Emotional violence by the partner					
No	3,729 (86.3)	3,598 (96.5)	131 (3.5)	3,040 (81.5)	689 (18.5)
Yes	592 (13.7)	473 (79.9)	119 (20.1)	296 (50.0)	296 (50.0)

^aPercentages (%) for the total population are presented as column percentages.

^bPercentages (%) for Major Depressive Disorder (MDD) and Generalized Anxiety Disorder (GAD) are presented as row percentages, reflecting the distribution of each disorder across categories.

A total of 87.8% (6,507) had practiced traditional separation practices during menstrual at any point of their lives. Eighteen percent (18.5%; 1,371) of women justified wife beating, and 30.8% (2,279) were not able to negotiate sex with their spouse. Fifty-three percent (52.6%; 2,909) of women were not involved in making household decisions. A total of 23.8% (1,227) experienced physical violence after the age of 15, while 7.9% (406) reported being sexually abused in their life and 13.7% (592) were emotionally abused by their spouse. The prevalence of major depressive disorder and generalized anxiety disorder among reproductive aged women was 5.4% (95% CI: 4.9 – 6.0) and 21.9% (95% CI: 20.9 – 23.0) respectively (Table 1).

Population attributable fractions for major depressive disorder

As shown in Table 2, the highest PAFs of depression were associated with women who experienced emotional abuse (PAF: 18.2%; 95% CI: 15.4 - 20.2), physical violence (PAF: 12.1%; 95% CI: 5.1 - 16.7), sexual abuse (PAF: 9.0%; 95% CI: 5.9 - 11.5), functional difficulty (PAF: 6.9%; 95% CI: 2.8 - 10.1) and food insecurity (PAF: 6.6%; 95% CI: 4.4 - 8.4). These five potentially modifiable risk factors accounted for 52.8% (95% CI: 33.7 - 67.0) of depression among women of reproductive age.

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Table 2. Population Attributable Fractions for major depressive disorder and generalized anxiety disorder among reproductive age women years in Nepal (n=4,202).

Risk factors	Major Depressive Disorder				Generalized Anxiety Disorder			
	Risk factor prevalence % (95% CI)	OR (95% CI)	Unadjusted PAF % (95% CI)	Adjusted PAF ^a % (95% CI)	Risk factor prevalence % (95% CI)	OR (95% CI)	Unadjusted PAF % (95% CI)	Adjusted PAF ^a % (95% CI)
Functional difficulty								
No	66.1 (60.9, 70.9)	Ref	Ref	Ref	68.8 (66.3, 71.3)	Ref	Ref	Ref
Yes	33.9 (29.1, 39.1)	1.67 (1.2, 2.34)**	13.7 (4.8, 22.4)	6.9 (2.8, 10.1)	31.2 (28.7, 33.7)	1.86 (1.53, 2.27)***	14.5 (9.9, 18.9)	7.8 (5.7, 9.6)
Food insecurity								
No	79.9 (75.6, 83.7)	Ref	Ref	Ref	87.1 (85.3, 88.7)	Ref	Ref	Ref
Yes	20.1 (16.3, 24.4)	2.84 (1.86, 4.36)***	13 (7.5, 18.8)	6.6 (4.4, 8.4)	12.9 (11.3, 14.7)	2.15 (1.61, 2.87)***	6.9 (4.3, 9.6)	3.7 (2.4, 4.9)
Experienced physical violence since age 15								
No	45.6 (39.6, 51.8)	Ref	Ref	Ref	60.4 (57.1, 63.5)	Ref	Ref	Ref
Yes	54.4 (48.2, 60.4)	1.78 (1.22, 2.6)**	23.9 (8.7, 37.2)	12.1 (5.1, 16.7)	39.6 (36.5, 42.9)	1.57 (1.27, 1.95)***	14.4 (7.8, 20.9)	7.8 (4.4, 10.6)
Ever experienced sexual abuse								
No	71.3 (65.4, 76.6)	Ref	Ref	Ref	81.8 (79.1, 84.2)	Ref	Ref	Ref
Yes	28.7 (23.4, 34.6)	2.61 (1.76, 3.88)***	17.7 (10.1, 25.7)	9.0 (5.9, 11.5)	18.2 (15.8, 20.9)	2.35 (1.76, 3.14)***	10.5 (6.8, 14.2)	5.6 (3.9, 7.3)
Emotional abuse by the partner								
No	52.4 (45.9, 58.8)	Ref	Ref	Ref	69.9 (66.6, 73.1)	Ref	Ref	Ref
Yes	47.6 (41.2, 54.1)	4.06 (2.77, 5.94)***	35.9 (26.3, 45)	18.2 (15.4, 20.2)	30.1 (26.9, 33.4)	3.02 (2.33, 3.9)***	20.1 (15.4, 24.8)	10.8 (8.7, 12.7)

CI: confidence interval; PAF: population attributable fraction; OR: odds ratio.

Statistical significance is indicated as $p < 0.05^*$, $p < 0.01^{**}$, $p < 0.001^{***}$.

^aAdjusted PAF represents the relative contribution of each risk factor to the overall population attributable fraction after accounting for communality among exposures.

PAF estimates are based on the analytic sample ($n = 4,202$) with complete data on all variables included in the models and are presented only for modifiable risk factors that showed statistically significant associations in the fully adjusted multilevel logistic regression models. Full multilevel regression results for all modifiable risk factors examined are provided in the Supplementary Materials (Supplementary Tables S1-S2).

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Population attributable fractions for generalized anxiety disorder

According to Table 2, the highest PAFs of anxiety were associated with women who experienced emotional abuse (PAF: 10.8%; 95% CI: 8.7 - 12.7), physical violence (PAF: 7.8%; 95% CI: 4.4 - 10.6), functional difficulty (PAF: 7.8%; 95% CI: 5.7 - 9.6), sexual abuse (PAF: 5.6%; 95% CI: 3.9 - 7.3), and food insecurity (PAF: 3.7%; 95% CI: 2.4 - 4.9). The highest PAFs of five risk factors accounted for 35.7% (95% CI: 25.2 - 45.1) of anxiety. Figure 2 presents the adjusted PAFs for individual risk factors contributing to depression and anxiety, ranked by descending impact, with emotional abuse showing the highest PAF for both conditions.

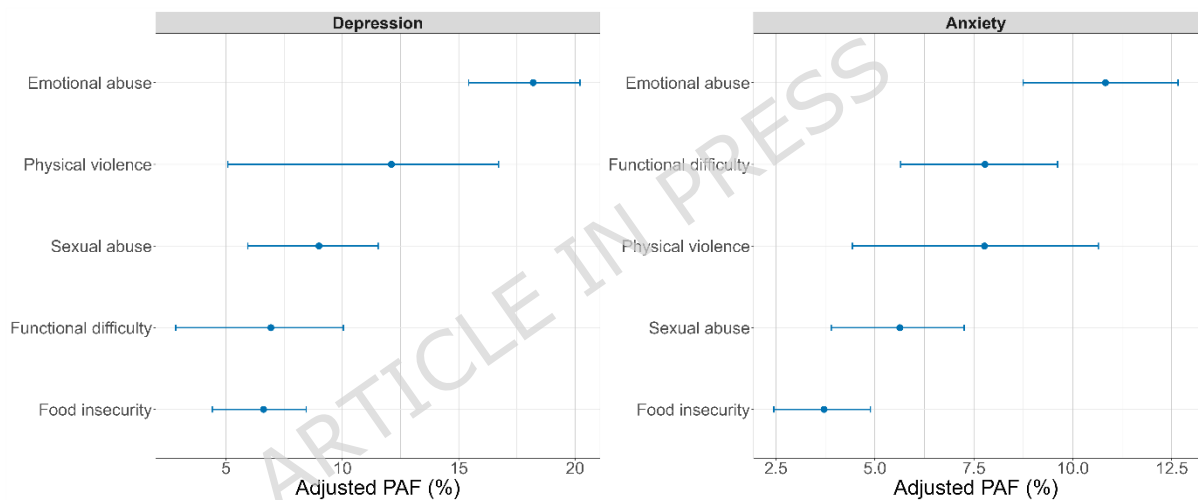


Figure 2. Population Attributable Fractions (PAFs) for major depressive disorder and generalized anxiety disorder among women of reproductive age (15-49 years) in Nepal

Discussion

This study provides, to our knowledge, one of the first population-level estimates of the proportion of major depressive and generalized anxiety disorder among reproductive-age women in Nepal that could theoretically be prevented by addressing key modifiable risk factors. By applying PAF methodology, our findings

shift the focus from identifying correlates of mental disorders to quantifying their potential preventable burden at the population level, an important distinction for informing prevention-oriented mental health policy in low-resource settings. These PAF estimates should be interpreted as conditional, potentially preventable fractions under strong causal assumptions, which cannot be fully verified in a cross-sectional design.

Our results indicate that over half of the burden of MDD and more than one-third of the burden of GAD could be attributed to a combination of violence against women, food insecurity, and functional difficulties. These exposures rarely operate independently; instead, they reflect a clustering of social, economic, and health-related adversities that disproportionately affect women in patriarchal and resource-constrained contexts²⁹. Prior studies on depression and anxiety among reproductive-age women have reported broader determinants, including occupational stressors (e.g., job strain), health risk factors (e.g., obesity) and past traumatic events (e.g., child maltreatment)^{30,31}. In Nepal, however, gendered social structures and norms may restrict women's access to education, financial opportunities, and autonomy, increasing vulnerability to violence and material deprivation²⁹. Informed by this context, our study incorporated locally relevant and potentially modifiable factors such as traditional menstrual practices, functional difficulties, women's involvement in household decision making, and violence against women, to better capture the realities shaping women's mental health^{10,32}.

The strong contribution of violence (emotional, physical, and sexual) to the PAFs of both disorders is consistent with a substantial body of literature demonstrating robust associations between intimate partner violence and common mental disorders across diverse cultural settings^{33,34}. High PAFs in our study indicate

that reductions in violence exposure could yield meaningful population-level mental health gains. Food insecurity and functional difficulty also emerged as important contributors to both MDD and GAD. Food insecurity operates as a chronic stressor, increasing psychological distress through pathways involving uncertainty, social shame, and reduced coping capacity³⁵⁻³⁷. Functional limitations may increase vulnerability to mental disorders through reduced autonomy, social exclusion, and economic dependence^{38,39}, mechanisms that may be particularly salient for women in settings where social protection systems are limited⁴⁰. The co-occurrence of these risk factors highlights the multidimensional nature of mental health vulnerability among women, reinforcing the need for integrated prevention strategies rather than single-factor interventions.

The policy relevance of these findings must be considered in the context of Nepal's mental health system and comparable LMICs. Despite the high burden of common mental disorders, mental health consistently receives a small, and in some settings declining, share of national health budgets, with resources largely prioritised for the treatment of severe conditions^{2,41,42}. Evidence from other LMICs indicates that interventions targeting upstream social determinants, such as gender-based violence, food insecurity, and disability, can yield meaningful mental health gains while remaining feasible within constrained health systems⁴³. Integrating mental health objectives into existing social protection schemes, violence prevention initiatives, food security programs, and disability-inclusive policies may represent a pragmatic and scalable approach to reducing the population burden of depression and anxiety. These findings underscore the importance of prioritising prevention strategies that enhance women's economic participation, educational opportunities, and community-based support

structures, such as women's groups and existing local health and social resources, which may strengthen mental health resilience while aligning with broader prevention-oriented policies in Nepal and similar LMIC settings⁴⁴⁻⁴⁶.

Violence against women has well-documented intergenerational effects, with children who experience or witness violence at higher risk of adverse mental health, behavioural, and health outcomes across the life course^{47,48}. These pathways contribute to the persistence of mental disorders, substance use, chronic disease, and the perpetuation of violence in adulthood⁴⁹. Interventions that disrupt the intergenerational cycles, particularly family- and couple-based approaches, are therefore essential components of long-term mental health prevention strategies.

Strengths and limitations of this study

The primary strength of this study is that it relies on a nationally representative dataset encompassing 7,410 women of reproductive age to investigate the PAFs for key risk factors of generalized anxiety disorder and major depressive disorder. Several limitations should be acknowledged. First, the cross-sectional design precludes causal inference, and PAF estimates rely on assumptions of causality, independence of risk factors, and temporal stability. We used adjusted odds ratios as approximations of relative risks in the PAF formula; while this is appropriate for relatively rare outcomes such as MDD, the higher prevalence of GAD may result in some overestimation of its PAF. Second, although the NDHS employs various strategies to mitigate possible recall bias, including standardized questionnaires, clearly defined recall periods, and intensive interviewer training, recall bias may still affect variables like past experiences of violence or food insecurity, which rely on retrospective reporting. Third, because the analytic sample was restricted to

women with complete data on exposures, outcomes, and covariates, our findings may be subject to bias if missingness was not entirely at random. Finally, the PAF calculations assume causation, independence of modifiable risk factors, and consistent relationships throughout time⁵⁰. However, generalizations about women's mental health should be made with caution due to complex socio-economic, cultural, healthcare, and behavioural issues. Despite these limitations, PAFs provide a simple, straightforward, and intuitive metric for identifying modifiable risk factors for policy intervention, complementing other methodological approaches.

Conclusions

A substantial proportion of MDD (53%) and GAD (36%) among reproductive-age women in Nepal is statistically associated with experiences of physical, sexual, and emotional abuse, household food insecurity and functional difficulty, as estimated using population attributable fractions. While the cross-sectional design precludes causal inference and PAF estimates rely on assumptions of causality and temporal stability, these results highlight potential population-level mental health gains achievable by reducing exposure to these modifiable or intervenable social adversities. Experiences of abuse and food insecurity extend beyond individual mental health outcomes, with implications for economic productivity, health system burden, and the persistence of social inequality. Strengthening gender-responsive, economically focussed, and prevention-oriented interventions, supported by sustained political commitment, is critical for improving mental health and wellbeing of women and families in Nepal.

List of Abbreviations

CI Confidence Interval

GAD Generalised Anxiety Disorder
MHM Mental Health Module
NDHS Nepal Demographic and Health Survey
OR Odds Ratio
PAF Population Attributable Fraction
PCA Principal Component Analysis
PHQ Patient Health Questionnaire

Authors' Contribution

SG: Conceptualization, Methodology, Investigation, Software, Formal analysis, Writing - Original Draft; NR: Writing- Reviewing and Editing; RK: Writing- Reviewing and Editing; AGR: Investigation, Writing- Reviewing and Editing; KYA: Methodology, Software, Validation, Formal analysis, Writing- Reviewing and Editing; PA: Investigation, Writing- Reviewing and Editing; MMH: Writing- Reviewing and Editing; AEA: Writing- Reviewing and Editing; FHA: Writing- Reviewing and Editing; SM: Writing- Reviewing and Editing; ST: Conceptualization, Methodology, Validation, Formal analysis, Writing- Reviewing and Editing, Supervision

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Ethics approval

The NDHS received ethical approval from the Ethical Review Board of Nepal Health Research Council (Reference number: 678, Date: Sep 30, 2021) and the institutional review board of ICF International (Reference number: 180657.0.001.NP.DHS.01, Date: April 28, 2022). All procedures were conducted in accordance with relevant ethical guidelines and regulations, including the principles outlined in the Declaration of Helsinki. Informed consent was obtained from all participants prior to the interviews.

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication

Not applicable

Data availability statement

The datasets supporting the conclusions of this article are available in the DHS repository, (<https://dhsprogram.com/data/available-datasets.cfm>). The DHS provides open access to survey data files for legitimate academic research purposes. To initiate the download process, registration is mandatory. Researchers are required to provide their contact information, research title, and a brief description of the proposed analysis. Approval for dataset access is typically confirmed via email. It is important to note that these datasets are third-party resources and not under the ownership or collection of the authors, who possess no special access privileges.

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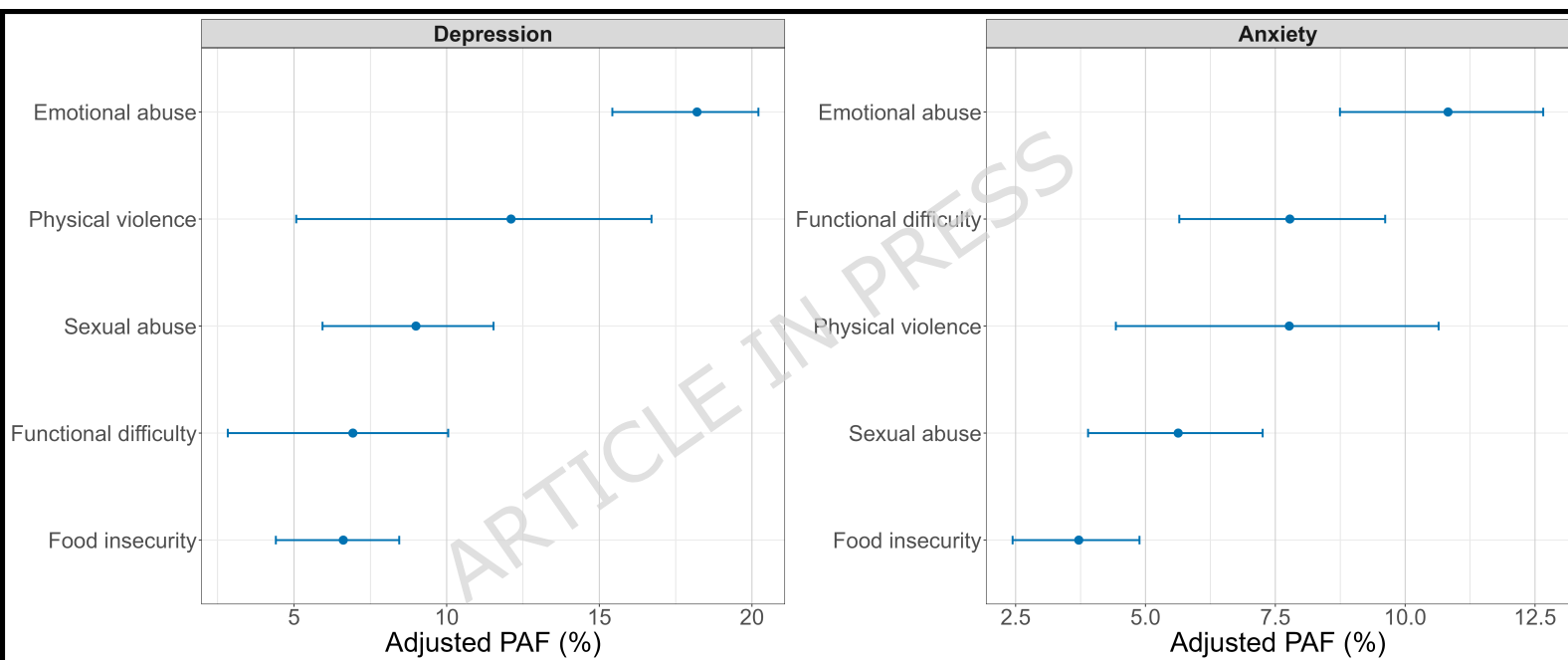
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Total NDHS 2022 sample of reproductive-aged women: 14,845

Completed mental health assessment: 7,410

Complete data on all selected modifiable risk factors & covariates: 4,202

Exclusion due to missing:

- Household decision-making: 24.5%
- Experienced physical violence: 30.4%
- Experienced sexual violence: 30.4%
- Experienced emotional violence: 14.1%
- Food insecurity: 0.2%